INSTRUCTION MANUAL

H.F. WAVE ANALYZER
MODEL 158A

PHILCO
A SUBSIDIARY OF Ford Motor Company

SIERRA ELECTRONIC DIV.
3885 BOHANNON DR., MENLO PARK, CALIFORNIA

Stock No. 950000026

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This warranty does not apply to any of our products which have been repaired, worked upon or altered by persons not authorized by us so as, in our sole judgment, to injure the stability or reliability of such instrument, or which have been subject to misuse, negligence or accident, or the serial number of which has been altered, effaced, or removed. Neither does this warranty apply to any of our products which have been connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by us. Nor does SIERRA ELECTRONIC DIVISION, PHILCO CORPORATION assume any liability for consequential damages, and in any event our liability shall in no case exceed the original purchase price of the instrument. Accessories, including but not limited to all vacuum tubes, fuses and batteries, not of our manufacture used with this product are not covered by this warranty.

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Manufactured by

PHILCO
A SUBSIDIARY OF Ford Motor Company

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3885 BOHANNON DR., MENLO PARK, CALIFORNIA

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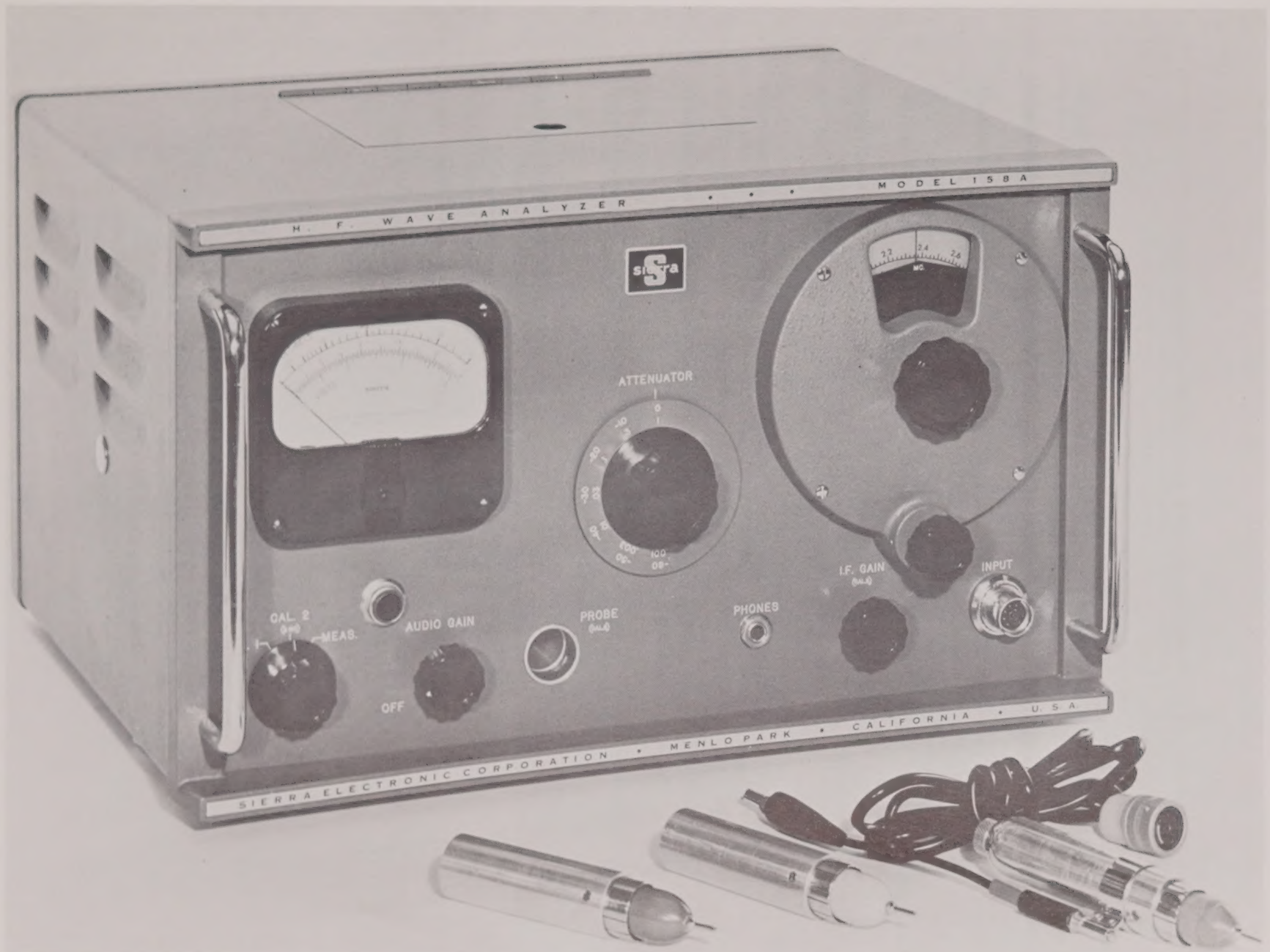
H. F. WAVE ANALYZER
MODEL 158A
Sierra
ATTENUATOR
MC.
I.F. GAIN
INPUT
CAL. 2
MEAS.
AUDIO GAIN
OFF
PROBE
PHONES
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SUMMARY OF TECHNICAL SPECIFICATIONS

Power Input	105-125 volts, 95 watts, 50/60 cps
Fuse Protection	2 amp 3AG
Frequency Range	.5 MC to 10 MC
Input Level Range (with 20 db and 40 db capacitive attenuators)	-80 dbm to +42.2 dbm (77.5 microvolts to 100 volts)
Selectivity	
1. 3 db down	2 kc
2. 45 db down	5 kc
Voltage Accuracy	± 2 db (between -10 db and +2 db on meter scale)
Frequency Measuring Accuracy	From ± .056 MC at low end to ± .08 MC at high end
Input Impedance	Approx. 1 megohm shunted by less than 6 mmfd
Overall Dimensions	
Width	17"
Height with stand up	12-1/4"
Height with stand down	10-1/4"
Depth	14-1/2"
Weight	35 pounds

OPERATING AND MAINTENANCE INSTRUCTIONS

for

MODEL 158A H.F. WAVE ANALYZER

1. GENERAL

The Model 158A H. F. Wave Analyzer is a selective detector for measuring voltages in the frequency range of 0.5 mc to 10 mc and is designed for wave analysis purposes. The input, or bridging impedance, is high (approximately 1 megohm shunted by less than 6 micro-microfarads) and the instrument is direct reading in volts and dbm when its input probe is bridged across 600-ohm (unbalanced) circuits. Two capacitive divider attachments, an attenuator and an indicating meter provide an overall sensitivity range of -80 dbm to +42.2 dbm (77.5 microvolts to 100 volts at the input probe terminals). A jack is provided on the front panel for monitoring the incoming signal with headphones.

The analyzer is equipped with an injection oscillator, which is in effect a signal generator, for the purpose of calibrating its sensitivity to input voltages.

2. DESCRIPTION

The front view of the wave analyzer is shown in Fig. 1. A Block Diagram, Fig. 2, is included to help the user understand the functions of the analyzer. The circuit schematic is shown on Fig. 5.

a. Input Circuit

The signal input to the probe input terminal first passes through a cathode follower amplifier contained within the probe, and thence through a length of coaxial cable to the input filter section of the analyzer before arriving at the grid of the first mixer tube. The input filter has a pass band from 0.5 mc to 10 mc. Its purpose is to suppress all signals outside this band. The capacitive divider attachments when used with the probe merely reduce by known amounts the signal arriving at the grid of the cathode follower tube so as to increase the voltage measuring range of the instrument and make possible the measurement of relatively large voltages. The most important function of these capacitive divider attachments is to adjust the magnitude of the signal voltages impressed on the cathode follower grid and first mixer grid to a value which is below that which would generate significant harmonic distortion components, or would produce undesirable intermodulation effects. The capacitive divider units provide a 10:1 and a 100:1 voltage reduction ratio respectively (i.e. 20 db attenuation, and 40 db attenuation respectively), and are employed when input signal levels in the range of 1 to 10 volts and 10 to 100 volts are encountered.

b. Converter Circuits

The MC tuning dial on the front of the analyzer controls the frequency of a variable frequency local oscillator over a range of 22.5 mc to 32 mc. The output of the oscillator combines (heterodynes) with the incoming signal in the first mixer tube to produce an intermediate frequency (I.F.) of 22 mc. After passing through a selective bandpass transformer in the 22 mc I.F. amplifier, the signal combines in the second mixer tube with the output from a 20.89 mc crystal controlled oscillator to produce a second intermediate frequency of 1110 kc. After passing through a highly selective bandpass transformer in the 1110 kc I.F. amplifier, the signal is applied to the grid of a cathode follower stage, the cathode circuit of which contains the main ATTENUATOR.

The main ATTENUATOR is calibrated in terms of both decibels and full-scale voltage value. Its steps are marked on the attenuator dial in 10 db intervals between 0 db and -60 db and in corresponding voltage ratios. Unlike the input capacitive dividers, the main ATTENUATOR operates at only one frequency, 1110 kc, and is accurately calibrated. Signals from the main ATTENUATOR pass through a selective 1110 kc I. F. amplifier circuit and go directly into the crystal detector, the dc output of which operates the DECIBELS meter and the audio output of which is connected via the AUDIO GAIN control to the audio amplifier. The I.F. GAIN (CAL.2) control, which is provided for adjusting the overall gain of the analyzer, is contained in the cathode circuit of tube (V5), in the 1110 kc I.F. amplifier section.

c. Decibels Meter

The output indicating meter has a 0-200 microampere range, but the scale is calibrated in both decibels and volts. The meter calibrations in conjunction with the calibrations on the attenuator dial indicate the voltage levels at the probe input terminal.

d. Calibrations

The instrument calibrations are based on one milliwatt dissipated in 600 ohms, recognized as 0 dbm. The voltage appearing across the resistor is 0.775 volts rms. With the ATTENUATOR set at 0 db or 1, the DECIBELS METER will show 0 db or 0.775 volts when 0.775 volts is applied between the input probe terminal and ground.

e. Listening Jack

A PHONES jack is provided on the front panel for the use of a headset, to listen to incoming signals. The headset is energized from an audio amplifier, the audio level of which is adjustable from the AUDIO GAIN control on the front panel.

f. Tuning Dial

The MC tuning dial on the front panel has two knobs. The larger knob, centrally located on the dial assembly, is for making coarse tuning adjustments. The smaller knob, located at the lower edge of the assembly, is a rim-drive control for making fine tuning adjustments. The tuning dial indicates the input signal frequency directly in megacycles (MC).

g. Calibration Oscillator

A calibration oscillator, which operates at 2 mc, is included in the analyzer. This oscillator provides a fixed amplitude signal (0.775 volts) which can be applied to the input probe terminal for calibration purposes. When the CALIBRATE-MEASURE switch is placed in the CAL.2 position, the plate voltage is connected to the calibration oscillator and a 2 mc signal of 0.775 volts rms value becomes available at the PROBE (CAL.2) jack on the front panel. The probe is designed to plug in to this jack for calibration purposes.

The calibration oscillator circuit contains a vacuum tube voltmeter for monitoring the amplitude of oscillations to insure an accurate injection signal amplitude of "0" dbm at 2 mc. The dc output from this vacuum tube voltmeter circuit is shown on the DECIBELS meter when the CALIBRATE-MEASURE switch is in the CAL.1 position. This circuit is adjusted for an indication of 0 db when operating properly.

h. Regulated Voltage

The dc voltages used in the analyzer are regulated in the power supply section. The object of this arrangement is to insure relatively constant voltage in the instrument under conditions where the 115 volt mains supply is not constant. An adjustment is provided for setting the B supply voltage at its nominal 225 volt value.

i. Supply Voltage

This wave analyzer is designed to operate from a main supply of 115 volts, 50/60 cycles. It will operate satisfactorily in the range from 105 volts to 125 volts. The power switch is incorporated in the AUDIO GAIN control; turn clockwise for ON position.

j. Power Consumption

The wave analyzer total power consumption is approximately 95 watts.

k. Fuse

A fuse for the main supply is located in a holder on the rear of the chassis, and is accessible for replacement by unscrewing and withdrawing the black cap marked FUSE. Replacement fuses should be rated at 3 amperes and of the Littlefuse or Bussman 3AG type.

l. Dimensions

The overall dimensions of the analyzer are: 13-1/2" deep (over handles) by 17" wide by 10-1/4" high, including rubber feet.

m. Weight

The weight of the complete analyzer is approximately 35 pounds.

3. PERFORMANCE CHARACTERISTICS

a. Sensitivity

The wave analyzer is capable of measuring voltage equivalent to -80 dbm to +42.2 dbm or 77.5 microvolts to 100 volts rms, using only that portion of the DECIBELS meter scale between -20 db and +2.2 db. Refer to paragraph 2d above for calibration. The way in which sensitivity varies with frequency is shown in a typical sensitivity curve in Fig. 3.

b. Accuracy

Over the frequency range 0.5 to 10 mc, the overall accuracy at any attenuator setting and meter reading (between -10 and +2 db on the meter scale) is within ± 2 db. Less accuracy is obtained when using the DECIBELS meter scale below the -10 db mark.

c. Frequency Calibration

The MC tuning dial, which is calibrated in the range from 0.5 to 10 mc indicates the input signal frequency directly in mc and depends for its accuracy upon the factory calibration accuracy and the stability of the 22.5 to 32 mc variable oscillator. Since this oscillator is calibrated and maintained to within 0.25%, the resulting tuning dial accuracy will range from ± 0.056 mc at the low frequency end of the dial to ± 0.080 mc at the high frequency end.

d. Selectivity

At frequencies 2 kc off resonance, the response is approximately 3 db down. At 5 kc off resonance, the response is at least 10 db down; at 10 kc, at least 26 db down; and at 20 kc, at least 45 db down. A typical selectivity curve is shown in Fig. 4.

e. Spurious Responses

Spurious responses originating within the wave analyzer are kept to a low magnitude when the instrument is operated in accordance with the operating instructions given herein. There are various types of spurious responses generally encountered in equipments of this type, and they have been classified and defined in various standards and textbooks related to the radio engineering art. For the convenience of the reader, applicable descriptions of some of these categories are given below:

Harmonic Distortion is generated when the signal amplitude applied to the grid of a vacuum tube is large enough to cause operation over more than the linear range of the grid-plate characteristic.

Direct I. F. Responses can take place when signals applied to the input terminals are at frequencies equal to that of the Intermediate Frequency Amplifiers used within the equipment, when the MC tuning dial is not adjusted to a setting which would "tune-in" these frequencies.

Image Responses can take place when the frequency of the signal applied to the input terminals is twice the Intermediate Frequency above the MC tuning dial setting.

Oscillator Beats can produce a spurious meter reading, in the absence of an applied input signal, when the difference between the variable oscillator frequency (or any of its harmonics) and the crystal oscillator frequency (or any of its harmonics) corresponds to the frequency (1110 kc) of the 2nd I.F. Amplifier in the wave analyzer. Although this phenomenon can occur at many different settings of the MC tuning dial, only a very few are prominent enough to be detectable or to be concerned within this analyzer.

Representative values of the various type of spurious responses are as follows:

Harmonic Distortion

2nd harmonic:	-55 db to -60 db with respect to applied pure sine wave
3rd harmonic:	-65 db to -75 db with respect to applied pure sine wave
High harmonics:	less than -70 db with respect to applied pure sine wave

Direct I.F. Responses

22 mc:	52 to 60 db rejection
1110 kc:	more than 70 db rejection

Image Responses

44 mc above tuning dial setting:	50 db rejection
2220 kc above tuning dial setting:	55 to 70 db rejection

Oscillator Beats

At 8.78 mc tuning dial setting:	-80 dbm
At 6.023 mc tuning dial setting:	better than -80 dbm
At 5.383 mc tuning dial setting:	better than -80 dbm
At 3.29 mc tuning dial setting:	better than -80 dbm
At 2.846 mc tuning dial setting:	better than -80 dbm

f. Input Impedance

The input impedance of the wave analyzer is essentially that of its cathode-follower input probe and is equivalent to approximately a 1 megohm resistance shunted by less than 6 mmf of capacitance at all frequencies. The capacitive divider attachments are designed to the same input capacitance as the probe.

4. OPERATION

a. Gain Standardization Using Calibration Oscillator

The calibration oscillator is adjusted at the factory to deliver a 2 mc signal of 0.775 volts rms to the wave analyzer input probe for calibrating purposes when the CALIBRATE-MEASURE switch on the front panel is placed in the CAL.2 position. The input probe is plugged into the PROBE (CAL.2) receptacle for this adjustment.

In order to make certain the amplitude from the calibration oscillator is correct, the dc output from the diode vacuum tube voltmeter circuit in the calibration oscillator may be switched to the DECIBELS meter by placing the CALIBRATE-MEASURE switch in the CAL. 1 position. The circuit is adjusted at the factory to indicate "0" db on the meter when operating properly.

To use the calibration oscillator:

1) Turn the wave analyzer on by rotating the AUDIO GAIN control knob clockwise from its extreme counterclockwise position. Allow the instrument to warm up for at least 15 minutes.

2) Plug the input probe (without capacitive divider attachments) into the PROBE (CAL.2) receptacle.

3) Place the CALIBRATE-MEASURE switch in the CAL.1 position. The DECIBELS meter should show "0" db. (IF not, see maintenance section below for adjustment instructions.)

4) Place the CALIBRATE-MEASURE switch in the CAL.2 position, set the ATTENUATOR dial at "0" db, and adjust the MC tuning dial for maximum reading on the DECIBELS meter when tuned to the 2 mc calibration oscillator signal. If the resultant DECIBELS meter reading is not "0" db it should then be set to this value by means of the I.F. GAIN (CAL.2) control knob. The wave analyzer sensitivity is now adjusted to its standard gain value.

5) Place the CALIBRATE-MEASURE switch in the MEAS. position and withdraw the input probe from the PROBE (CAL.2) receptable. The wave analyzer is now ready for making measurements.

b. General Measurement Methods

After carrying out the calibration procedure outlined above, the following measurement procedure should be employed.

1) Touch the tip contact of the input probe to the "high" side of the signal circuit to be measured, after first having attached the ground-lead clip to a suitable ground point in the area of of the circuit.

2) With the main ATTENUATOR set at "0" tune the wave analyzer over its entire frequency range of .5 mc to 10 mc and find the input signal frequency component having the largest amplitude. This is usually the fundamental component if a single source of signal energy is acting upon the circuit; but it may be any one of a group of harmonically-unrelated signals if, for example, a multi-channel signal system is involved. If this largest signal component produces a meter deflection in excess of full-scale, attach either the 20 db or 40 db capacitive divider to the probe so that the DECIBELS meter reading occurs somewhere between -15 db and +2 db on its scale. If no signal component is present which is large enough to give the above reading even with no capacitive divider attached, turn the ATTENUATOR down by one 10 db step and repeat the tuning procedure using only the input probe without dividers. Continue until successful. Note the combined reading of the capacitive divider (if used), ATTENUATOR dial and DECIBELS meter for the largest signal component.

3) With the input probe and capacitive divider combination unchanged from the result arrived at in the above operation, proceed now to tune in the various other signal components whose levels are desired, and for each one, adjust the ATTENUATOR dial to that position necessary for a meter

reading in the -10 to +2 db region of the scale. Note the combined reading of the capacitive divider, ATTENUATOR dial and the DECIBELS meter for each of these components.

4) The db differences between each of the various combined readings obtained in step 3 and the combined reading obtained in step 2 (for the largest amplitude component) then represent the relationships of the lower-amplitude components to the largest amplitude component.

As an illustrative example, assume the wave analyzer is being used to measure the harmonic content of a 2 mc signal source feeding a 600-ohm circuit. The wave analyzer is first standardized for gain as indicated in section 4a above. Its probe is then connected across the 600-ohm load and the 2 mc input signal is tuned in, and, with the main ATTENUATOR dial left at its "0" setting the appropriate capacitive divider attachment (if needed) is selected as required to give a reading between -15 and +2 db on the DECIBELS meter. Suppose this meter reading is -2 db, when the 20 db capacitive divider (10:1 voltage reduction ratio) is attached. This indicates that the fundamental component of the signal source output has a level of 0 +20 -2 = +18 dbm. Without changing the 20 db capacitive divider, rotate the frequency dial of the wave analyzer to tune in the second harmonic (4 mc) of the signal source under test, adjusting the setting of the ATTENUATOR dial to give a suitable DECIBELS meter reading. Suppose this meter reading is "-7" db, when the ATTENUATOR dial is set at -30. From this, the second harmonic output level of the signal generator is -30 +20 -7 = -17 dbm, which is -35 db with respect to the fundamental. Other harmonic components may be measured in the same manner.

Obviously the voltage levels corresponding to the above mentioned dbm values can be read directly and used to arrive at the equivalent voltage ratio values of the various signal components if the user so desires.

c. Gain Standardization Using External Source

If it is desired to use an external source for gain standardization, the I.F. GAIN control on the front panel of the wave analyzer should be adjusted to produce a 0 db reading on the DECIBELS meter with the ATTENUATOR dial set at 0, the MC tuning dial tuned to the incoming signal and with a signal amplitude of 0.775 volts rms applied to the input probe tip contact. With this adjustment the wave analyzer is set at its standard gain point, i.e., at normal sensitivity. For general sensitivity checks, the frequency used should be approximately 2 mc. However, for maximum accuracy this adjustment should be made with the calibrating source frequency in the region of the frequencies under measurement. Always make certain that the tuning dial is set for maximum response to the input frequency.

d. Tuning Dial

The MC tuning dial on the front panels reads directly in megacycles over the signal frequency range of 0.5 to 10 mc. The center knob is used to turn the dial when large changes of frequency are desired, whereas the small rim-drive knob below is used for "fine" tuning. The special spiral dial scale has an effective length of 33 inches and the pointed shutter sliding vertically in the dial window indicates which section of the scale is to be read.

Measurements below 0.4 mc should not be attemped because an error is introduced in the reading when the frequency of the 22.5 to 32 mc variable heterodyne oscillator approaches that of the 22 mc I.F. circuit. This error is evident by the large DECIBELS meter deflection in the region of zero on the MC tuning dial.

e. Calibration Oscillator Harmonics

The calibrating voltage is selected from a portion of the 2 mc Calibration Oscillator circuit which is rich in harmonics in order to produce usable DECIBELS meter deflections when the MC tuning dial is adjusted to the harmonics of 2 mc, i.e., to the 4 mc, 6 mc, 8 mc, and 10 mc settings. This feature is provided for a quick check of the MC tuning dial frequency calibration.

CAUTION Use only the 2 mc tuning dial setting for gain standardization purposes when using the Calibration Oscillator as a source of known amplitude signal, since the harmonic voltage amplitudes differ from the amplitude of the 2 mc fundamental.

f. Use of Headphones

A headset may be used for listening to the incoming signals, by plugging into the PHONES jack below the tuning dial. The audio level is adjustable by means of the control knob labeled AUDIO GAIN. The headset should be of the high impedance type, preferably above 10,000 ohms, because low impedance phones will not respond as well.

5. MAINTENANCE

a. General

For purposes of reference, schematic diagram E-4596-4 and parts list SA-4585-1 are attached. The Wave Analyzer should require no maintenance during normal use except for occasional change of tubes and the removal of dust and dirt. The change of power supply regulator tubes V11, V12, and V13 may require that the regulator potentiometer "V" be readjusted to obtain the correct B-supply value of 225 volts.

Adjustment "V" is located on the top of the chassis near the case of the DECIBELS meter. The change of mixer or I.F. amplifier tubes V2, V3, V5, and V6 may possibly affect the sensitivity of the instrument. Therefore, a recalibration of gain should be made, using either the internal calibration oscillator or an external source of known amplitude voltage preferably around 2 mc (See instruction in section 4c above). If it is found that standard sensitivity is not attainable within the nominal ± 7 db range of adjustment afforded by the I.F. GAIN (CAL.2) control, the wave analyzer circuits should be realigned and/or readjusted as later described.

b. Calibration Oscillator

If the calibration oscillator tube V7 is changed, the following adjustment procedure should be followed, after allowing at least a 20 minute warm-up period:

1) With CALIBRATE-MEASURE switch in the CAL.1 position adjust potentiometer shaft "W" (on top of chassis near front) with screwdriver to give 0 db reading on DECIBELS meter.

2) Place CALIBRATE-MEASURE switch in CAL.2 position, plug probe into PROBE (CAL.2) receptacle and adjust frequency of calibration oscillator to 2 mc by using a screwdriver in inductor tuning screw slot at location marked "H" on top middle of chassis. Tuning can be accomplished by direct beating of calibration oscillator with external frequency standard; or by tuning calibration oscillator frequency for maximum deflection of DECIBELS meter when MC tuning dial is set to 2 mc. The latter 2 mc tuning dial point should, for maximum accuracy, be preset against an external frequency standard.

3) After frequency of the calibration oscillator has been set, the DECIBELS meter should read 0 db (providing first that the wave analyzer sensitivity level has been properly adjusted by means of the I.F. GAIN (CAL.2) control in accordance with the External Calibration instructions given in section 4c above). If pointer on DECIBELS meter is not at 0 db, the correct calibration level can be set by adjusting potentiometer shaft "P" (at top front of chassis) with a screwdriver. Interaction between adjustment "H", "P", and "W" may require that the above procedure be repeated several times.

c. Variable Frequency Oscillator

In case it is necessary to change tube V8 (mounted in a horizontal position above the chassis, on the oscillator shield box) in the variable oscillator circuit

(to which the tuning dial is connected), it may also be necessary to readjust some of the circuit constants so that the MC tuning dial calibration accuracy is preserved. The adjustments are accomplished as follows:

1) Adjust the frequency of the calibration oscillator to exactly 2 mc in accordance with Para. 5b 2 above. (The CALIBRATE-MEASURE switch is in the CAL.2 position for this condition).

2) Set the MC tuning dial at 10 mc, plug the input probe into the PROBE (CAL.2) receptacle, and set the ATTENUATOR dial to -20 and adjust the variable oscillator trimmer capacitor "X" with a screwdriver for maximum response (to calibration oscillator 5th harmonic) on the DECIBELS meter. The trimmer adjustment "X" is accessible through a hole located on the side of the shield box adjacent to the oscillator tube V8.

3) Set the MC tuning dial to 2 mc, and the ATTENUATOR dial to 0 db, and adjust the variable oscillator inductor screw "0" (around the corner from the trimmer capacitor "X") for maximum response (to the 2 mc fundamental of the calibration oscillator) on the DECIBELS meter.

4) Since there is a slight amount of interaction between the settings of "X" and "0", steps 5c2 and 5c3 should be repeated three or four times to arrive at the proper final settings for these adjustments.

5) As a final check tune to the 4 mc, and 8 mc harmonics of the calibration oscillator to verify that the frequency calibration of the tuning dial is within the specified accuracy limits over the entire range.

d. Alignment Procedure

In the event it is found necessary to electrically realign the wave analyzer, as mentioned in 5a, the following procedure is recommended:

1) From a suitable low-impedance signal generator apply 2400 microvolts rms at 1110 kc between grid No. 1 (Pin 1) of vacuum tube V5 and the chassis and tune I.F. coils L12 and L11 for maximum response on the DECIBELS meter. The locking nuts on the core screws of the above coils (and of L10 and L9 below) should be loosened slightly just prior to the tuning adjustment and then re-tightened after the adjustment is completed, being careful not to disturb the settings of the adjustment screws in the tightening process. The I.F. GAIN

(CAL.2) control should be set at about its center value for the above adjustments, and the CALIBRATE-MEASURE switch should be in the MEAS.position.

2) Set ATTENUATOR dial to 0. Apply .11 volts rms at 1110 kc between grid #3 (Pin 7) of V3 and the chassis and tune I.F. coils L10 and L9 for maximum response. Coupling between these coils is provided by capacitor C24, which is adjusted at the factory to a value just below critical coupling. Its setting must not be altered.

3) Without disconnecting the signal generator from the above circuit location, change its output frequency to 22 mc (at .11 volts rms) to check the operation of V3 as a mixer stage. For normal operation the DECIBELS meter should indicate near 0 reading.

4) Connect the signal generator between grid #3 (Pin 7) of V2 and chassis ground, and, with its output set to give .037 volts rms at 22 mc tune the core screw adjustments of I.F. coils L8 and L7 to give maximum response on the DECIBELS meter. (The ATTENUATOR dial should be set to 0 db for this adjustment).

5) With the signal generator connected as in the above step, rotate the I.F. GAIN (CAL.2) control over its range of adjustment (which is approximately 14 db) to determine whether a 0 db DECIBELS meter reading can be obtained within the range of I.F. GAIN (CAL.2) control. The setting for 0 db should not be too near either end of the I.F. GAIN control range. If it is, adjustment of special coupling capacitor C18 may be made (by bending the plates slightly) to center the range of action of the I.F. GAIN (CAL.2) control. C18 is located on the under side of the chassis in the partition of the shield box beneath quartz crystal Y1.

6) Connect the signal generator to the probe contact and adjust its level to give approximately 1 volt rms at 22 mc. Adjust the inductor core screw marked "L" (located on top of the chassis behind variable oscillator shield box) to obtain a minimum reading on the DECIBELS meter, turning the ATTENUATOR dial down to the -40 or -50 db step if necessary.

e. Special Adjustments

Changing the first mixer tube, V2, may require readjustment of a special

purpose circuit constant other than those covered in the alignment instructions given in section 5d above. This circuit constant is the cathode bias potentiometer marked "K". It is adjusted as follows:

1) Feed a 2 mc pure sine-wave signal (i.e., harmonics at least 70 db below fundamental, by means of a good lowpass filter) into the wave analyzer probe contact at a level of 0.775 volts rms, tune wave analyzer to 4 mc and adjust potentiometer "K" for a minimum reading on the DECIBELS meter. This adjustment yields the cathode bias value giving minimum 2nd harmonic distortion in the combined dynamic signal characteristic of V1 and V2. It will be necessary to turn the ATTENUATOR dial down to its -50 or -60 db position for the final stage of this adjustment if optimum results are desired. The shaft of potentiometer "K" is located on top of the chassis adjacent tube V2.

2) If a pure sine-wave signal of the type specified above is not available, a compromise adjustment of potentiometer "K" can be made by feeding a 2 mc signal (of no more than 1% distortion) into the wave analyzer, tuning the dial to 2 mc and adjusting "K" to obtain maximum reading of the DECIBELS meter. This maximum indication will tend to be broad, so that the optimum adjusting point using this compromise method is somewhat obscure. Nevertheless, reasonably good performance of the wave analyzer can be realized from this method.

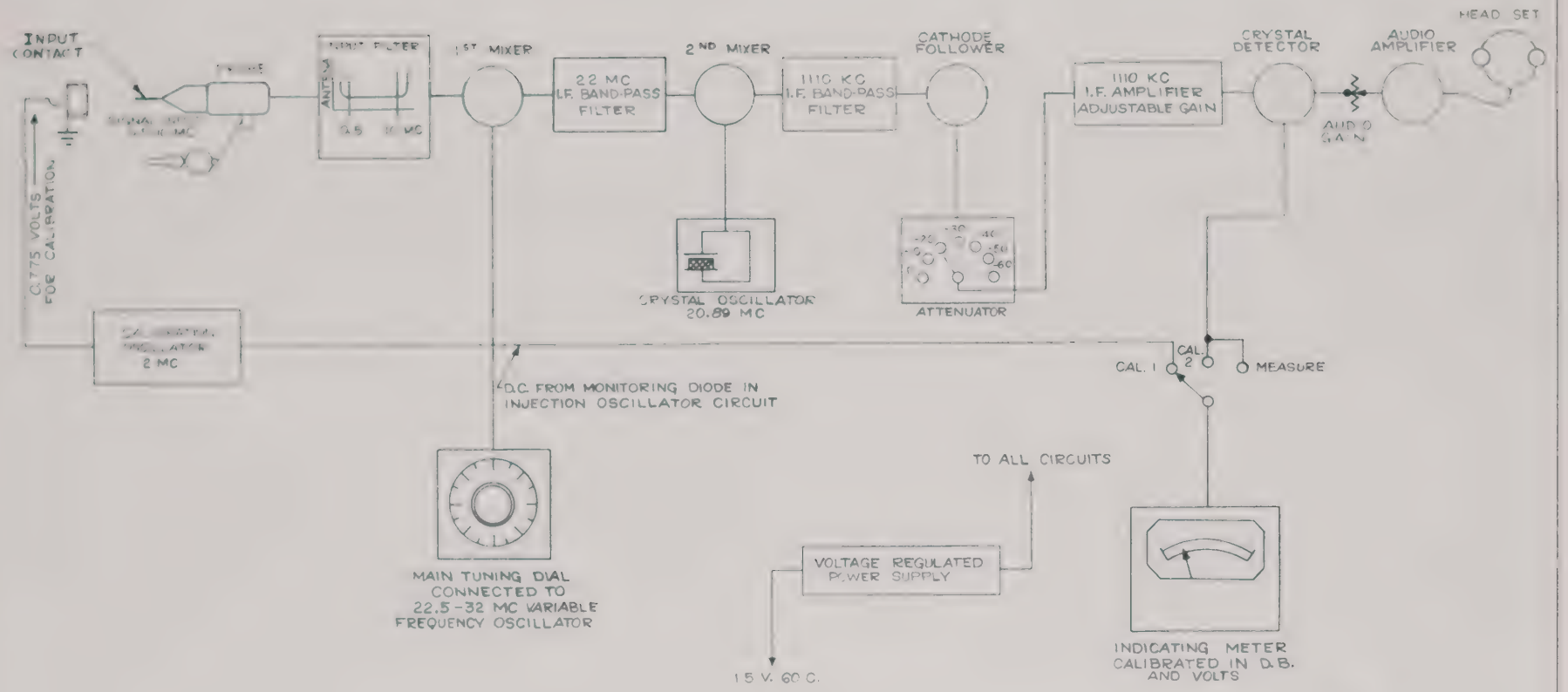


FIG. 2

BLOCK DIAGRAM
H.F. WAVE ANALIZER MODEL 158

SIERRA ELECTRONIC CORPORATION

DATE: 3-28-55 DWG. NO. E-6709-2

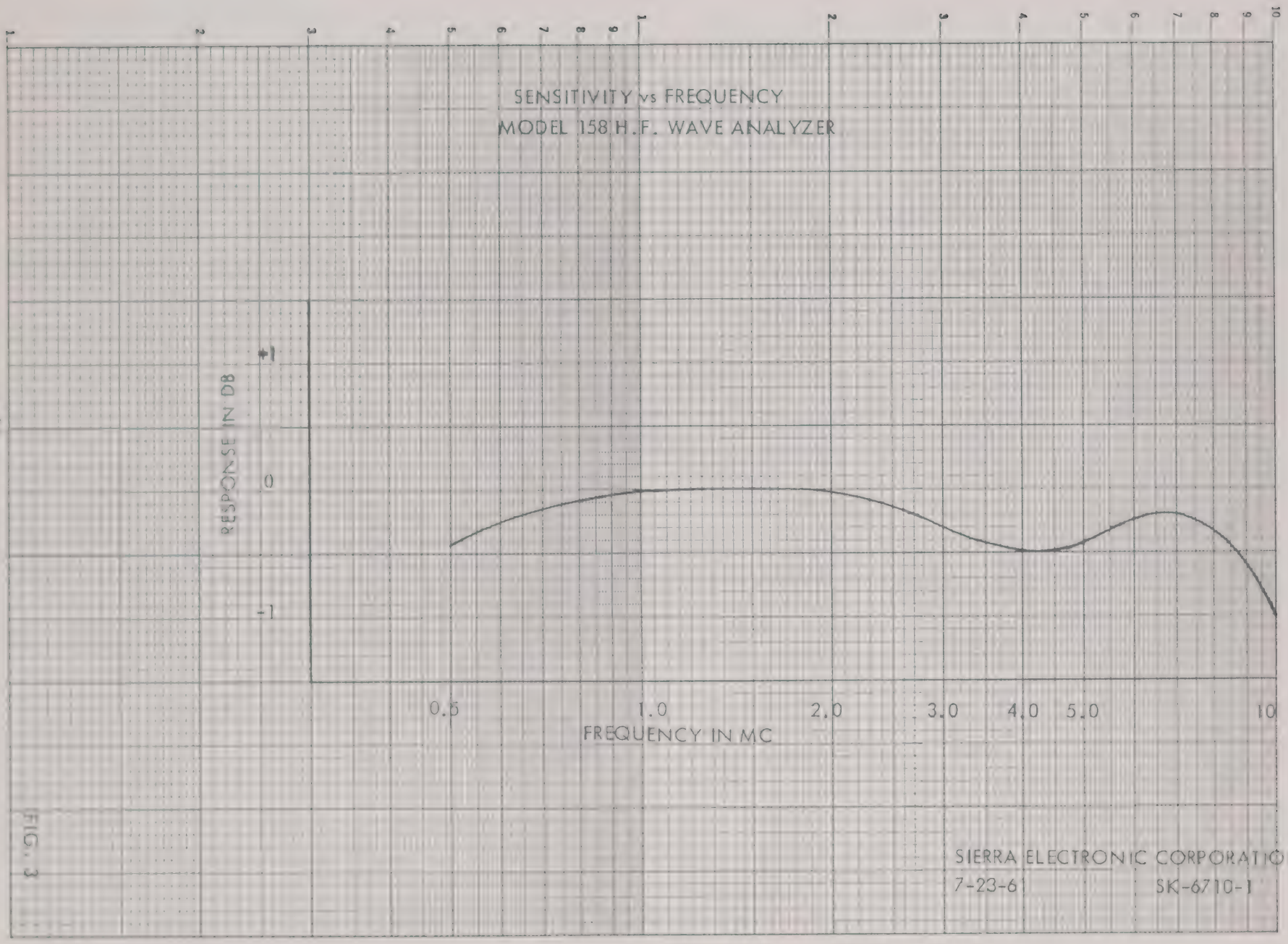

SENSITIVITY vs FREQUENCY
MODEL 158 H.F. WAVE ANALYZER
RESPONSE IN DB
+1
0
-1
0.5
1.0
2.0
3.0
4.0
5.0
10
FREQUENCY IN MC
SIERRA ELECTRONIC CORPORATION
7-23-61
SK-6710-1

FIG. 3

SELECTIVITY CURVE

MODEL 158 H.F. WAVE ANALYZER

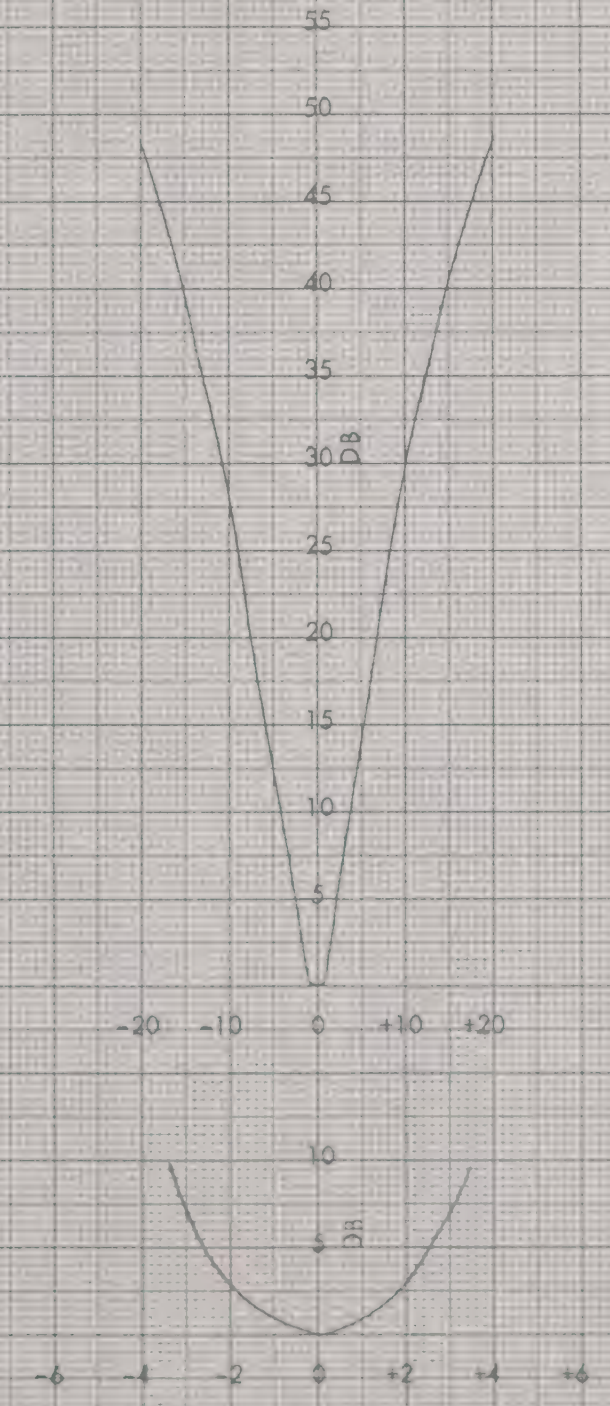


FIG. 4
SIERRA ELECTRONIC CORP.
3-23-55 SK-6712-1

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr. or Supplier	Designation
C1	Silver Mica, 500 mmf ± 10% 600 Vdcw	901420501	Erie	GD2K
C2	Ceramic 1.5-12mmf	903210120	CTC	CST-50
C3	Silver Mica 445 mmf ± 2% 500 Vdcw	901814450	Erie	370-CH
C4	Ceramic 1.5 - 12 mmf	903210120	CTC	CST-50
C5	Silver Mica 40 mmf ± 2% 500 Vdcw	901810400	Erie	370-CH
C6	Ceramic .001 mf 500 Vdcw	901410102	Erie	Z5U-ED-.001
C7	Ceramic .02 mf 500 Vdcw	901400203	Centralab	DD-203
C8	Silver Mica 117 mmf ± 3% 500 Vdcw	902081170	El-Menco	CM15D1170H
C9	Silver Mica 1, 930 mmf ± 2% 500 Vdcw	902071931	El-Menco	CM20D-1931G
C10	Silver Mica 1, 930 mmf ± 2% 500 Vdcw	902071931	El-Menco	CM20D-1931G
C11	Silver Mica 234 mmf ± 3% 500 Vdcw	901812340	Erie	370CB
C12	Silver Mica 105 mmf ± 3% 500 Vdcw	901811050	Erie	370CB
C13	Silver Mica 15 mmf ± 5% 500 Vdcw	902010150	El-Menco	CM15C150J
C14	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C15	Silver Mica 2 mmf ± 5% 500 Vdcw	902040020	El-Menco	CM15C020J
C16	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C17	Silver Mica 100 mmf ± 5% 500 Vdcw	902010101	El-Menco	CM15E101J
C18	Variable Air	102881000	Sierra	
C19	Silver Mica 100 mmf ± 5% 500 Vdcw	902010101	El-Menco	CM15E101J
C20	Silver Mica 10 mmf ± 5% 500 Vdcw	902010100	El Menco	CM15C100J
C21	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C22	Silver Mica 510 mmf ± 2% 300 Vdcw	902070511	El-Menco	CM15E511G
C23	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C24	Ceramic 1.5-7 mmf 500 Vdcw	903210070	Erie	TS2A
C25	Silver Mica 510 mmf ± 2% 300 Vdcw	902070511	El-Menco	CM15E511G
C26	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C27	Ceramic .01 mf + 80% - 20% 500 Vdcw	901400103	Erie	811
C28	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C29	Ceramic .02 mf GMV 500 Vdcw	901400203	Centralab	DD-203
C30	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C31	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C32	Silver Mica 510 mmf ± 2% 300 Vdcw	902070511	El-Menco	CM15E511G
C33	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C34	Ceramic .02 mf GMV 500 Vdcw	901400203	Centralab	DD-203
C35	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C36	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C37	Silver Mica 510 mmf ± 2% 300 Vdcw	902070511	El-Menco	CM15E511G
C38	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C39	Ceramic .01 mf + 80% - 20% 500 Vdcw	901400103	Erie	811
C40	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C41	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C42	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801

Electrical Parts List for Schematic Diagram No. E-4596-4

MODEL 158A HIGH FREQUENCY WAVE ANALYZER

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr. or Supplier	Designation
C43	Silver Mica 240 mmf ± 5% 500 Vdcw	902010241	El-Menco	CM15E241J
C44	Silver Mica 470 mmf ± 5% 300 Vdcw	902010471	El-Menco	CM15E471J
C45	Silver Mica 100 mmf ± 5% 500 Vdcw	902010101	El-Menco	CM15E101J
C46	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C47	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C48	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C49	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C50	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C51	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C52	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C53	Ceramic 47 mmf ± 5% 500 Vdcw	901400470	Erie	N750K47±2.5
C54	Variable Air 53 mmf	902810530	Sierra	SS-7353-1
C55	Ceramic 3-13 mmf 500 Vdcw	903200130	Erie	TS2A-N300
C56	Ceramic 20 mmf ± 5% 500 Vdcw	901400200	Erie	301-N150
C57	Silver Mica 4.7 mmf ± 5% 500 Vdcw	902010470	El-Menco	CM15E470J
C58	Silver Mica 10 mmf ± 5% 500 Vdcw	902010100	El-Menco	CM15C100J
C59	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C60	Ceramic .02 mf GMV 500 Vdcw	901400203	Centralab	DD-203
C61	Electrolytic 25 mf 25 Vdcw	902200256	Sprague	TVA-1205
C62	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C63	Ceramic .02 mf GMV 500 Vdcw	901400203	Centralab	DD-203
C64	Paper .01 mf ± 20% 600 Vdcw	901030103	Sprague	47P6
C65	Paper .01 mf ± 20% 600 Vdcw	901030103	Sprague	47P6
C66	Electrolytic 20-20 mf 450 Vdcw	902210206	Sangamo	PLD4520
C67	Ceramic .01 mf + 80% - 20% 500 Vdcw	901400103	Erie	811
C68	Paper .1 mf ± 20% 400 Vdcw	901020104	Sangamo	300401
C69	Ceramic .02 mf GMV 500 Vdcw	901400203	Centralab	DD-203
C70	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
C71	Ceramic .001 mf GMV 500 Vdcw	901400102	Erie	801
CR1	Germanium diode	910500034	Sylvania	1N34
F1	Fuse, 2 ampere, type 3AG	913200001	Littelfuse	312003
I1	Indicator Lamp 6-8 volt 0.15 amperes	913800001	Nat-Union	N47
J1	Jack, Phone, Single	914400003	Switchcraft	12-A
L1	Fixed 38.6 microhenries ± 3%	909000057	Sierra	SS-4526-1
L2	Fixed 2.34 microhenries ± 3%	909000055	Sierra	SS-4605-1
L3	Fixed 10.3 microhenries ± 3%	909000056	Sierra	SS-4604-1
L4	Fixed 2.34 microhenries ± 3%	909000055	Sierra	SS-4605-1
L5	Fixed 38.6 microhenries ± 3%	909000057	Sierra	SS-4526-1
L6	Variable 3.5 microhenries Nom.	909400022	Sierra	SS-4779-1
L7	Variable .48 microhenries Nom.	909400018	Sierra	SS-4782-1
L8	Variable .48 microhenries	909400018	Sierra	SS-4782-1
L9	Variable 41 microhenries Nom. Q200	909400030	Sierra	

Electrical Parts List for Schematic Diagram E-4596-4

MODEL 158A HIGH FREQUENCY WAVE ANALYZER

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr. or Supplier	Designation
L10	Variable 41 microhenries Nom Q200	909400030	Sierra	
L11	Variable 41 microhenries Nom Q200	909400030	Sierra	
L12	Variable 41 microhenries Nom Q200	909400030	Sierra	
L13	Variable 39.6 microhenries Nom	909400021	Sierra	SS-4524-1
L14	Fixed three pie 1 microhenry	909000058	Millen	34106
L15	Variable .5 microhenry Nom	909400020	Sierra	SS-4783-1
L16	Fixed 1.22 microhenries ± 5%	909000054	Sierra	SS-4606-1
L17	Variable 2.3 microhenries Nom	909400019	Sierra	SS-4780-1
M1	Meter 200 microampere 400 ohms	911800004	Sierra	
P1	Plug and Line cord assembly 18/3 type SJ overall length 10 ft. 6 inches	916400002	Electro Cords	
R1	1 meg ± 10% 1/2 watt	905000105	AB	Type EB
R2	180 ohm ± 5% 1/2 watt	905000181	AB	Type EB
R3	750 ohm ± 5% 1/2 watt	905000751	AB	Type EB
R4	4.7K ± 10% 1 watt	905600472	AB	Type EB
R5	100 ohms ± 5% 1/2 watt	905000101	AB	Type EB
R6	Potentiometer 250 ohms ± 10% 2 watt	907900032	Sierra	
R7	39 ohms ± 10% 1/2 watt	905200390	AB	Type EB
R8	22K ± 10% 1/2 watt	905200223	AB	Type EB
R9	15K ± 10% 2 watt	906000153	AB	Type HB
R10	2.7K ± 10% 1/2 watt	905200272	AB	Type EB
R11	120 ohm ± 10% 1/2 watt	905200121	AB	Type EB
R12	22K ± 10% 1/2 watt	905200223	AB	Type EB
R13	15K ± 10% 2 watt	906000153	AB	Type HB
R14	2.7K ± 10% 1/2 watt	905200272	AB	Type EB
R15	1 meg ± 10% 1/2 watt	905200105	AB	Type EB
R16	22 ohms ± 10% 1/2 watt	905200220	AB	Type EB
R17	1K ± 10% 1/2 watt	905200102	AB	Type EB
R18	459 ohms ± 1% 1/2 watt	907400030	Electra	DC1/2C
R19	2.96K ± 1% 1/2 watt	907400031	Electra	DC1/2C
R20	1,081 ohms ± 1% 1/2 watt	907400007	Electra	DC1/2C
R21	341.9 ohms ± 1% 1/2 watt	907400021	Electra	DC1/2C
R22	108.1 ohms ± 1% 1/2 watt	907400019	Electra	DC1/2C
R23	34.19 ohms ± 1% 1/2 watt	907400004	Electra	DC-1/2C
R24	10.81 ohms ± 1% 1/2 watt	907400003	Electra	DC-1/2C
R25	5 ohms ± 1% 1/2 watt	907400015	Electra	DC-1/2C
R26	470K ± 10% 1/2 watt	905200474	AB	Type EB
R27	100 ohms ± 10% 1/2 watt	905200101	AB	Type EB
R28	Potentiometer 2.5K ± 10% 2 watt	907900017	Sierra	
R29	270K ± 10% 1/2 watt	905200274	AB	Type EB
R30	39K ± 10% 1 watt	905200393	AB	Type GB
R31	1.2K ± 10% 1/2 watt	905200122	AB	Type EB

Electrical Parts List for Schematic Diagram E-4596-4

MODEL 158A HIGH FREQUENCY WAVE ANALYZER

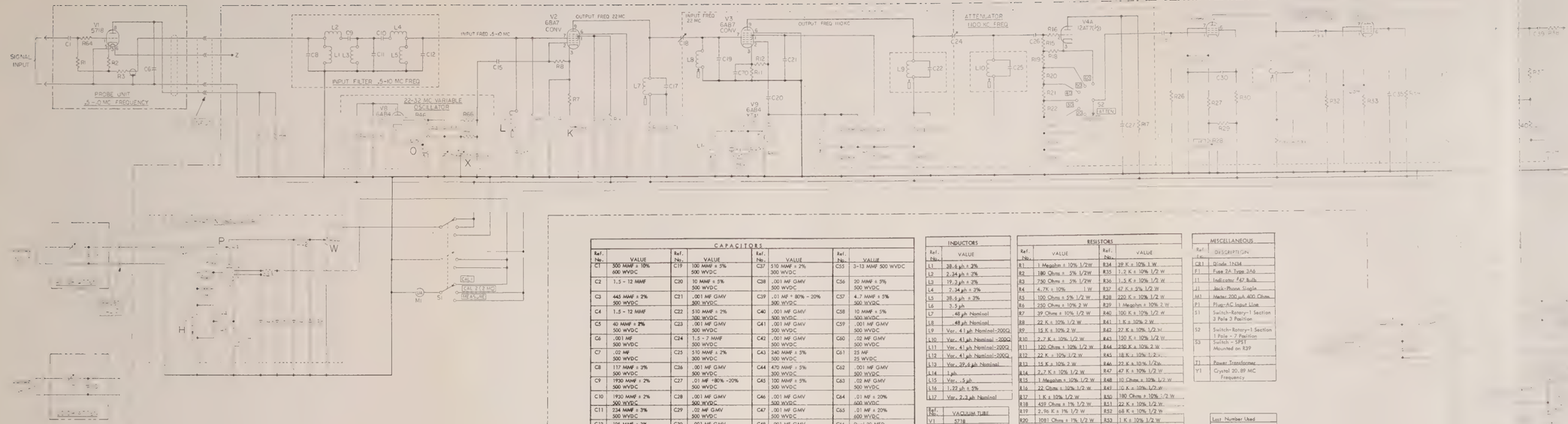
Schem. Ref. No.	Description	Sierra Stock No.	Mfgr. or Supplier	Designation
R32	1 meg. ± 10% 1/2 watt	905200105	AB	Type EB
R33	100 ohms ± 10% 1/2 watt	905200101	AB	Type EB
R34	39K ± 10% 1 watt	905600393	AB	Type GB
R35	1.2K ± 10% 1/2 watt	905200122	AB	Type EB
R36	1.5 ± 10% 1/2 watt	905200152	AB	Type EB
R37	47K ± 5% 1/2 watt	905000473	AB	Type EB
R38	220K ± 10% 1/2 watt	905200224	AB	Type EB
R39	Potentiometer 1 meg ± 10% 2 watt	907900011	Sierra	
R40	100K ± 10% 1/2 watt	905200104	AB	Type EB
R41	Potentiometer 1K ± 10% 2 watt	907900043	Sierra	
R42	27K ± 10% 1/2 watt	905200273	AB	Type EB
R43	150K ± 10% 1/2 watt	905200154	AB	Type EB
R44	Potentiometer 250K ± 10% 2 watt	907900009	Sierra	
R45	18K ± 10% 1/2 watt	905200183	AB	Type EB
R46	22 ohms ± 10% 1/2 watt	905200220	AB	Type EB
R47	47K ± 10% 1/2 watt	905200473	AB	Type EB
R48	10 ohms ± 10% 1/2 watt	905200100	AB	Type EB
R49	10K ± 10% 1/2 watt	905200103	AB	Type EB
R50	180 ohms ± 10% 1/2 watt	905200181	AB	Type EB
R51	22K ± 10% 1/2 watt	905200223	AB	Type EB
R52	68K ± 10% 1/2 watt	905200683	AB	Type EB
R53	1K ± 10% 1/2 watt	905200102	AB	Type EB
R54	47K ± 10% 1 watt	905600473	AB	Type GB
R55	270 ohms ± 10% 1/2 watt	905200271	AB	Type EB
R56	22 ohms ± 10% 1/2 watt	905200220	AB	Type EB
R57	2.2K ± 10% 1/2 watt	905200222	AB	Type EB
R58	25K ± 10% 10 watt	906400253	M.E.	FRL±10
R59	1 meg 10% 1/2 watt	905200105	AB	Type EB
R60	30 ohms ± 10% 1/2 watt	905200390	AB	Type EB
R61	47K ± 10% 1/2 watt	905200473	AB	Type EB
R62	Potentiometer 25K ± 10% 2 watt	907900034	Sierra	
R63	39K ± 10% 1/2 watt	905200393	AB	Type EB
R64	22 ohms ± 10% 1/2 watt	905200220	AB	Type EB
R65	8.2 ohms ± 10% 1 watt	905600082	AB	Type EB
S1	Rotary 3 position 1 section 3 poles	911200004	Sierra	
S2	Rotary 7 position 1 section 1 pole	911200006	Sierra	
T1	Plate and filament	910000003	Sierra	
V1	Tube electron 5718	910700064		
V2	Tube electron 6BA7	910700046		
V3	Tube electron 6BA7	910700046		
V4	Tube electron 12AT7	910700053		

Electrical Parts List for Schematic Diagram No. E-4596-4

MODEL 158A HIGH FREQUENCY WAVE ANALYZER

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr. or Supplier	Designation
V5	Tube electron 6BH6	910700023		
V6	Tube electron 6BH6	910700023		
V7	Tube electron 6AV6	910700045		
V8	Tube electron 6AB4	910700044		
V9	Tube electron 6AB4	910700044		
V10	Tube electron 5V4G	910700013		
V11	Tube electron 6Y6	910700035		
V12	Tube electron 6SJ7	910700028		
V13	Tube electron OB2	910700001		
XF1	Extractor post	913400001	Littelfuse	342003
X11	Socket, lamp	914200001	Johnson	147-403
XY1	Socket, crystal	914200007	Millen	33302
Y1	Crystal, quartz 20.89 mc ± .02% 3rd overtone	912200005	Std. Crystal	CR-23/U

Electrical Parts List for Schematic Diagram No. E-4596-4
MODEL 158A HIGH FREQUENCY WAVE ANALYZER



CAPACITORS

Ref. No.	VALUE	Ref. No.	VALUE	Ref. No.	VALUE	Ref. No.	VALUE
C1	500 MMF ± 10% 600 WVDC	C19	100 MMF ± 5% 500 WVDC	C37	510 MMF ± 2% 300 WVDC	C55	3-13 MMF 500 WVDC
C2	1.5 - 12 MMF	C20	10 MMF ± 5% 500 WVDC	C38	.001 MF GMV 500 WVDC	C56	20 MMF ± 5% 500 WVDC
C3	445 MMF ± 2% 500 WVDC	C21	.001 MF GMV 500 WVDC	C39	.01 MF + 80% - 20% 500 WVDC	C57	4.7 MMF ± 5% 500 WVDC
C4	1.5 - 12 MMF	C22	510 MMF ± 2% 300 WVDC	C40	.001 MF GMV 500 WVDC	C58	10 MMF ± 5% 500 WVDC
C5	40 MMF ± 2% 500 WVDC	C23	.001 MF GMV 500 WVDC	C41	.001 MF GMV 500 WVDC	C59	.001 MF GMV 500 WVDC
C6	.001 MF 500 WVDC	C24	1.5 - 7 MMF 500 WVDC	C42	.001 MF GMV 500 WVDC	C60	.02 MF GMV 500 WVDC
C7	.02 MF 500 WVDC	C25	510 MMF ± 2% 300 WVDC	C43	240 MMF ± 5% 500 WVDC	C61	25 MF 25 WVDC
C8	117 MMF ± 2% 500 WVDC	C26	.001 MF GMV 500 WVDC	C44	470 MMF ± 5% 300 WVDC	C62	.001 MF GMV 500 WVDC
C9	1930 MMF ± 2% 500 WVDC	C27	.01 MF +80% -20% 500 WVDC	C45	100 MMF ± 5% 500 WVDC	C63	.02 MF GMV 500 WVDC
C10	1930 MMF ± 2% 500 WVDC	C28	.001 MF GMV 500 WVDC	C46	.001 MF GMV 500 WVDC	C64	.01 MF ± 20% 600 WVDC
C11	234 MMF ± 2% 500 WVDC	C29	.02 MF GMV 500 WVDC	C47	.001 MF GMV 500 WVDC	C65	.01 MF ± 20% 600 WVDC
C12	105 MMF ± 2% 500 WVDC	C30	.001 MF GMV 500 WVDC	C48	.001 MF GMV 500 WVDC	C66	Dual 20 MFD 450 WVDC
C13	15 MMF ± 5% 500 WVDC	C31	.001 MF GMV 500 WVDC	C49	.001 MF GMV 500 WVDC	C67	.01 MF + 80% - 20% 500 WVDC
C14	.001 MF GMV 500 WVDC	C32	510 MMF ± 2% 300 WVDC	C50	.001 MF GMV 500 WVDC	C68	.1 MF + 20% 400 WVDC
C15	2 MMF ± 5% 500 WVDC	C33	.001 MF GMV 500 WVDC	C51	.001 MF GMV 500 WVDC	C69	.02 MF GMV 500 WVDC
C16	.001 MF GMV 500 WVDC	C34	.02 MF GMV 500 WVDC	C52	.001 MF GMV 500 WVDC	C70	.001 MF GMV 500 WVDC
C17	100 MMF ± 5% 500 WVDC	C35	.001 MF GMV 500 WVDC	C53	47 MMF ± 5% 500 WVDC	C71	.001 MF GMV 500 WVDC
C18	.25 - 3 MMF	C36	.001 MF GMV 500 WVDC	C54	VAR 53 MMF MAX		

INDUCTORS

Ref. No.	VALUE
L1	38.6 μh ± 2%
L2	2.34 μh ± 2%
L3	19.3 μh ± 2%
L4	7.34 μh ± 2%
L5	38.6 μh ± 2%
L6	3.5 μh
L7	46 μh Nominal
L8	48 μh Nominal
L9	Var. 41 μh Nominal -200Q
L10	Var. 41 μh Nominal -200Q
L11	Var. 41 μh Nominal-200Q
L12	Var. 41 μh Nominal-200Q
L13	Var. 29.6 μh Nominal
L14	1 μh
L15	Var. .5 μh
L16	1.22 μh ± 5%
L17	Var. 2.3 μh Nominal

Ref. No.	VACUUM TUBE
V1	5718
V2	6BA7
V3	6BA7
V4	12AT7
V5	6BH6
V6	6BH6
V7	6AY6
V8	6AB4
V9	6AB4
V10	5Y4G
V11	6Y6
V12	6GJ7
V13	OB2

RESISTORS

Ref. No.	VALUE	Ref. No.	VALUE
R1	1 Megohm ± 10% 1/2W	R34	39 K ± 10% 1 W
R2	180 Ohms ± 5% 1/2W	R35	1.2 K ± 10% 1/2 W
R3	750 Ohms ± 5% 1/2W	R36	1.5 K ± 10% 1/2 W
R4	4.7K ± 10% 1 W	R37	47 K ± 5% 1/2 W
R5	100 Ohms ± 5% 1/2 W	R38	220 K ± 10% 1/2 W
R6	250 Ohms ± 10% 2 W	R39	1 Megohm ± 10% 2 W
R7	39 Ohms ± 10% 1/2 W	R40	100 K ± 10% 1/2 W
R8	22 K ± 10% 1/2 W	R41	1 K ± 10% 2 W
R9	15 K ± 10% 2 W	R42	27 K ± 10% 1/2 W
R10	2.7 K ± 10% 1/2 W	R43	150 K ± 10% 1/2 W
R11	120 Ohms ± 10% 1/2 W	R44	250 K ± 10% 2 W
R12	22 K ± 10% 1/2 W	R45	18 K ± 10% 1/2 W
R13	15 K ± 10% 2 W	R46	22 K ± 10% 1/2W
R14	2.7 K ± 10% 1/2 W	R47	47 K ± 10% 1/2 W
R15	1 Megohm ± 10% 1/2 W	R48	10 Ohms ± 10% 1/2 W
R16	22 Ohms ± 10% 1/2 W	R49	10 K ± 10% 1/2 W
R17	1 K ± 10% 1/2 W	R50	180 Ohms ± 10% 1/2 W
R18	459 Ohms ± 1% 1/2 W	R51	22 K ± 10% 1/2 W
R19	2.96 K ± 1% 1/2 W	R52	68 K ± 10% 1/2 W
R20	1081 Ohms ± 1% 1/2 W	R53	1 K ± 10% 1/2 W
R21	341.9 Ohms ± 1% 1/2W	R54	47 K ± 10% 1 W
R22	108.1 Ohms ± 1% 1/2 W	R55	270 Ohms ± 1/2 W
R23	34.19 Ohms ± 1% 1/2W	R56	22 Ohms ± 10% 1/2 W
R24	10.81 Ohms ± 1% 1/2 W	R57	2.2 K ± 10% 1/2 W
R25	.5 Ohms ± 1% 1/2 W	R58	25 K ± 10% 10 W
R26	470 K ± 10% 1/2 W	R59	1 Megohm ± 10% 1/2 W
R27	220 Ohms ± 10% 1/2 W	R60	39 Ohms ± 10% 1/2 W
R28	7.5 K ± 10% 2 W	R61	47 K ± 10% 1/2 W
R29	270 K ± 10% 1/2 W	R62	25 K ± 10% 2 W
R30	39 K ± 10% 1 W	R63	39 K ± 10% 1/2 W
R31	1.2 K ± 10% 1/2 W	R64	22 Ohms ± 10% 1/2 W
R32	1 Megohm ± 10% 1/2 W	R65	18.2 Ohms ± 10% 1/2 W
R33	100 Ohms ± 10% 1/2 W	R66	10 Ohms ± 10% 1/2 W

MISCELLANEOUS

Ref. No.	DESCRIPTION
CR1	Diode 1N34
F1	Fuse 2A Type 3AG
I1	Indicator #47 Bulb
J1	Jack-Phone Single
M1	Meter 200 μA 600 Ohms
P1	Plug-AC Input Line
S1	Switch-Rotary-1 Section 3 Pole 3 Position
S2	Switch-Rotary-1 Section 1 Pole - 7 Position
S3	Switch - SPST Mounted on R39
T1	Power Transformer
Y1	Crystal 20.89 MC Frequency

Last Number Used
C71
CR1
F1
I1
J1
L17
M1
P1
R66
S3
T1
V13
Y1

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PARTS REPLACEMENT

To help in identifying and ordering replacement parts, the REPLACEMENT PARTS LIST contains the circuit symbol, commercial description and Sierra stock number.

To order parts from Sierra Electronic Division:

1. Give Sierra stock number of part to be ordered.
2. Give circuit symbol and commercial description of part to be ordered.
3. State name, model and serial number of the equipment containing part to be ordered.
4. Send order to:

SIERRA ELECTRONIC DIVISION
Philco Corporation
3885 Bohannon Drive
Menlo Park, California

For further service information on this unit, contact

SIERRA ELECTRONIC DIVISION
Philco Corporation
3885 Bohannon Drive
Menlo Park, California

Area Code 415

Telephone 326-2060

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The Sierra Electronic Division is just one of eight Philco divisions currently serving the needs of the government and the military. Their combined capabilities and talents represent an integrated organization with wide experience in all phases of electronic technology.

PHILCO STRUCTURE for Defense Electronics

Communications and Weapons Division

4700 Wissahickon Ave., Phila., Pa.

An organization experienced in engineering, manufacturing, and support of advanced communications systems and devices, radar, missile guidance and fuzing, counter-measures, weapon systems, underwater systems and advanced programs.

Communications Systems Division

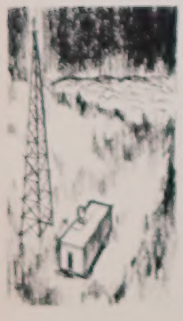
515 Pennsylvania Ave., Ft. Washington, Pa.

Planning, development, installation and management of command and control systems, communications, displays, data handling, and sensory systems for government and industry.

TechRep Division

C & Ontario Streets, Philadelphia, Pa.

A world-wide field engineering organization providing contract technical services in the fields of engineering, installation, maintenance, operation, technical training and technical publications.



Sierra Electronic Division

3885 Bohannon Drive, Menlo Park, Calif.

Development engineering and manufacturing of special purpose equipment and systems, including: communications and R.F. power test equipment, monitoring systems, R.F. power amplifiers and transmitters at all power levels and frequencies, navigational and telemetry systems.

Computer Division

3900 Welsh Road, Willow Grove, Pa.

Philco 2000 series of large-scale electronic data processing systems for military, government and scientific applications; and Basicpac mobile military computer systems.

Western Development Laboratories

3875 Fabian Way, Palo Alto, Calif.

System manager for space programs and ground support systems for space. Capabilities include system design and integration, complete vehicle systems and sub-systems, satellite control systems, range instrumentation systems, and other specialized space equipment.

Lansdale Division

Church Road, Lansdale, Pa.

A pioneer producer of germanium and silicon transistors, microwave diodes, IR detectors, microelectronic circuits and other solid state devices for switching and communications applications, high-speed semiconductor test equipment, and special purpose cathode ray tubes.

Scientific Laboratory

Union Meeting & Jolly Roads, Blue Bell, Pa.

Provides the basic and applied research support for the Corporation in all engineering and scientific disciplines. Main areas of investigation are: electronic materials and components; communications and detection; recognition, learning, and automation; mathematical physics.